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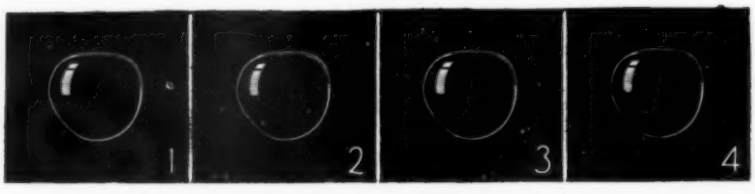

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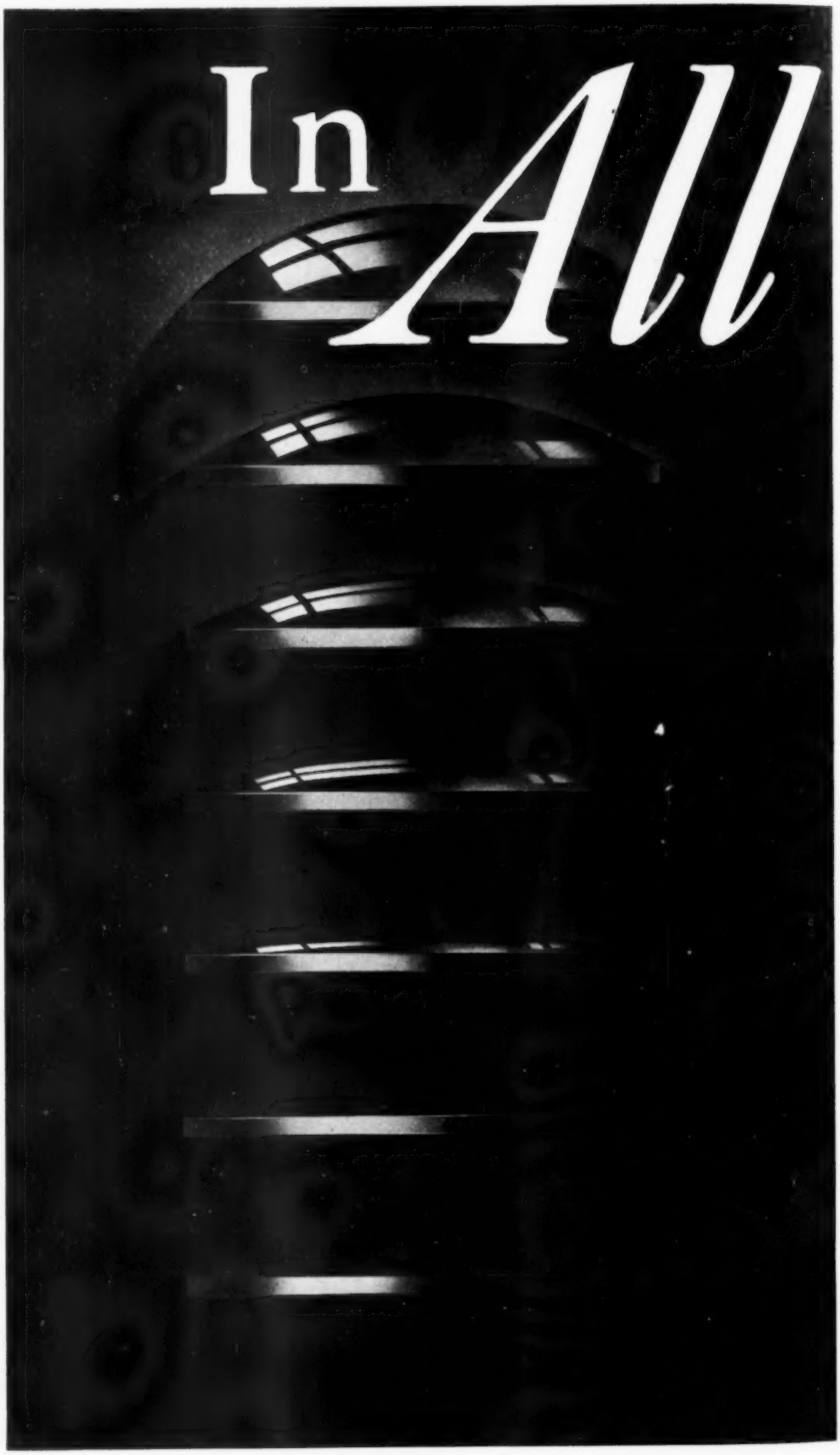
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AMERICAN JOURNAL OF OPTOMETRY

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A FURTHER REPORT ON PTOSIS CRUTCHES*

John C. Neill, O. D., F. A. A. O.
Philadelphia, Pa.

Since the original report[1] before the American Academy of Optometry in December, 1931, on the subject of ptosis and its relief by the use of a mechanical device, several improvements in technique have been developed and complications in the types and kinds of ptosis have been noted.

It is the purpose of this paper to present these improvements and complications so that those who have been using or are contemplating the use of the technique may be helped by the experience of others in such cases.

When the original report was written, it was mentioned that the crutch should be fitted in such a manner that it would lie in the "normal fold" of the lid, and that such being the case, no pressure or tension would be required; the lid being supported in "much the same manner as you would drape a piece of cloth or your coat over the back of a chair." That this normal fold was essential can be seen by referring to Case VI reported at the time. This case further served to demonstrate that not all ptosis sufferers could have a normal fold created in their lids. Since, in the case cited, surgical interference, in which a piece of the superior palpebrarum had been excised had been previously resorted to, this had been held to be the reason for our failure to secure the normal fold. That it is possible to have a case in which the normal fold is not present, and which cannot be created in the usual manner, in the absence of a history of surgical interference, is demonstrated by a case that will be described later in this paper.

Second only to a correct and accurate diagnosis of any condition is the necessity for an accurate prognosis. More often than not the patient is more interested in the prognosis than in the diagnosis. This is especially so with patients applying for mechanical ptosis correction. At the time of our previous report it was not possible to estimate the

*An abridgement of the material presented before the American Academy of Optometry at Baltimore, December 18, 1933.

[1]Transactions of the American Academy of Optometry, Vol. VI, p. 94, 1931.

success of the device until it had been made up and fitted, or, in other words, not until our work was practically completed. For quite obvious reasons this was a disadvantage and it stimulated us to find a method whereby the securing of a normal fold could be demonstrated during the preliminary examination.

After experimentation the solution was found to be quite simple. It consisted of an ordinary curved wire attached to a handle (we have frequently used an ordinary cable temple with the shank serving as a handle). The wire is curved somewhat to the approximate shape of the lid. Holding the device by the handle, the curved portion is placed against the affected lid at about the position where the normal fold would be expected and a slight upward pressure is applied. This pressure will râise the lid, and if it is possible to secure a normal fold it will be manifested at this time by the excess tissue draping itself over the wire. If it is not possible, by means of this test, to demonstrate the creation of a normal fold, it does not necessarily indicate that a crutch would be unsuccessful, but it certainly should lead us to be extremely cautious in predicting a good result.

To date the types of cases that have proven to be not amenable or only partially amenable to correction by means of the ptosis crutch, may be classified grossly under the following three groups:

TYPE A—Those cases wherein it is impossible to secure a normal fold because of a scarcity of palpebral tissue, ecdema, scar-tissue or atrophy. These conditions may be the result of surgical interference, traumatism, or may be congenital. Case VI cited in the previous report is a good example of Type "A." In this case it was impossible to secure the fold because of scarcity of tissue following surgical interference.

TYPE B—Those cases wherein there is an excess of palpebral tissue. In this type of case there is such an excess of tissue that even though the crutch be in the proper position, the lid still remains closed. Two types of this condition have been noted, one in which the excess superficial tissue was due to a loss of the underlying adipose structure (excessive loss of weight), and the other caused by a stretching of the lid over a long period of time.

TYPE C—Those cases wherein it is impossible to sufficiently elevate the lid because of a narrow palpebral fissure (Epicanthus). Type "C" may be a complication of Type "A," and is usually congenital.

The following case histories will serve to better illustrate the foregoing classification of ptosis cases and will describe in detail the method of adaptation used in each instance. .

Case VIII: Mr. H., age 18. Partial ptosis, bilaterally, since birth. Approximately two-thirds of the pupil is occluded when the head is held erect and fixation is directly ahead. It was impossible for the patient to completely close the lids. When told to do so, he rotates the globes vertically until the pupils are completely occluded by the superior palpebrarum. The palpebral fissure appeared to be narrowed

Dr John C.Neill. Case VIII.Binocular ptosis accompanied with epicanthus and oedema. Note the corrugation of forhead,arching of brows and general tension of face muscles. Figure One.

both nasally and temporally a total of three or four millimeters, the superior palpebrarum presented considerable oedema and the superficial skin appeared to be extremely taut. The effort on the part of the patient to elevate the lid sufficiently for vision resulted in a rather weird facial contortion in which the forehead was corrugated, the brows highly arched and the palpebral aperature appeared to be of the Mongoloid type. Since it was impossible to produce a satisfactory fold in the lid by means of the device previously described, the prognosis was quite indefinite. This was made known to the patient and the correction was attempted upon a basis of experimentation, the case being classified as a combination of Types "A" and "C."

Our first step in attempting to correct this case was to make up a crutch in the manner described in our previous report and to study its defects when applied to this particular case. The first difficulty to be encountered was in the inability to secure the normal fold because of the tautness and oedema. After considerable experimentation with

Dr John C.Neill. Case VIII. Lids elevated sufficiently for vision by means of ptosis crutch. Facial muscles relaxed and brows in normal position. Figure Two.

several different crutches, it was decided to construct one with considerably more stiffness and to lengthen the shank in such a manner as to force the lid into its proper position. For this purpose a wire of No. 18 gauge, 3% platinum, was used. This crutch was fitted in the usual manner and the patient brought into the office three times daily for adjustments. At first the pressure of the lids upon the crutch as transmitted to the frame resulted in the nose and ears becoming irritated and for several days the external tissue of the lids showed considerable inflammation.

After several days it was found that the lids were developing a normal fold and that the palpebral fissure was slightly wider. At this writing, four months after the initial fitting, the patient is able to wear the device with a minimum of discomfort, the fissure has widened still further and his appearance has been improved considerably. In this case there was also a high amount of uncorrected hyperoptic astigmia. The uncorrected visual acuity being O. D. 20/50 and O. S.

20/200. Corrected visual acuity was O. D. 20/40 and O. S. 20/65. After a few days of wearing the correction the visual acuity improved to O. U. 20/30. We mention this matter of the improvement in visual acuity since it had a distinct psychological effect that aided us in having the patient wear his glasses at all times.

Case IX: Mr. M., age 60. Complete binocular ptosis for past 30 years, accompanied with complete paralysis of both legs. The aetiology was undetermined. This patient has been using a piece of adhesive plaster attached to the lid and forehead on the O. S. in order to hold the lid open. The O. D. remained closed. As is usual in this method of supporting a lid, the adhesive was attached to the external surface of the lid and the lid drawn up and the upper end of the adhesive was attached to the brow. Over a period of years the lid was gradually stretched until thirty years after the condition was first manifested, the lid when closed, completely covered the lower lid and when held sufficiently high to clear the pupil, it completely covered the eyebrow. When the test crutch was applied to the lid the tissue enveloped it, but there was so much excess tissue that the lid could not be raised sufficiently high to permit vision. Upon examination, it was found that the lid of the O. D. was in good condition, since it had not been molested. The visual acuity, however, had diminished to about 20/100. It was suggested to the patient that the O. S. be taped open, temporarily, to see if the V. A. improved with use. If the vision improved sufficiently, a crutch could then be made for the O. S. At this writing nothing further has been attempted for this patient.

Case X: Mrs. S., age 63. Partial binocular ptosis for past six months. Upon examination it was found that the ptosis was a result of superfluous tissue rather than faulty innervation. This excess of tissue was a result of the wasting away of the underlying adipose material. Over a period of one year the patient's body weight had decreased from 250 pounds to 140 pounds. Application of the test crutch showed some improvement, but since medical treatment had been instituted, it was deemed advisable to await the outcome of this treatment before attempting to support the lids with crutches. Cases IX and X are both Type "C."

From the foregoing case histories we may draw the following conclusions: Those cases which fall into the classifications of Types "A" and "C," while not only always amenable to correction, the success encountered in some cases warrants an attempt at correction. Those cases classified as Type "B" are not amenable to correction with a mechanical device such as the ptosis crutch.

Since publication of our original report, we have received numerous communications telling of the successful handling of ptosis cases by means of our technique. In some instances, suggestions have been made for minor improvements in the technique and in the method of attaching the crutch to the frame.

We are indebted to Dr. Daniel M. Chasson of Baltimore for a suggested method of attachment wherein the crutch arm is affixed to

the bridge at a point about seven millimeters above the guard arm. The method consists in drilling in the bridge of the frame a small hole sufficiently large to accommodate the crutch shank. The crutch shank is inserted into this hole and soldered. The advantage claimed for this method of attachment is that the shank of the crutch is more completely hidden from view by the frame and the orbital and nasal angle.

It is hoped that experimentation on which we are working at the present time will eventually result in a technique or method that will enable us to successfully handle a larger percentage of Types "A" and "C" and that in time some method will be found to correct Type "B" cases.

DR. JOHN C. NEILL,
12TH STREET & SPENCER AVENUE,
PHILADELPHIA PA.

CONSIDERATIONS REGARDING THE ANALYSIS AND INTERPRETATION OF DATA ON OCULAR CONVERGENCE*

Charles Sheard, Ph.D., Sc.D.
Division of Physics and Biophysical Research, The Mayo Clinic and The Mayo Foundation, Rochester, Minn.

Introduction

Ocular refraction is both a science and an art. As a science, it consists of a considerable body of facts relative to the physiology of vision. These facts, as transmitted to us through the writings of Donders, Landolt, Helmholtz, Javal, Knapp, Maddox, and others who have gone "to join the innumerable caravan that moves to that mysterious realm," have formed the foundation on which has been built the modern science of ocular refraction. And these facts are being added to, year in and year out, by the ever-growing numbers of those who are interested in human vision, particularly in the errors of refraction and in the anomalies of accommodation and convergence as they are associated in the functions of binocular single vision. As an art, ocular refraction consists in the skill with which those whose practices are concerned with eyes and vision put into daily application the principles, tenets and philosophy of ocular science to the end that human eyes may carry on their natural function of seeing with the best possible acuity of vision and with the minimum of innervational demands upon the nervous system, of which the eyes are so intimate and important a part.

The importance of the analysis and interpretation of ocular data, especially as concerns the findings regarding accommodative and convergence demands and reserves, is apparent when it is realized that abnormal conditions of innervation to the ocular muscles exist in so many patients who present themselves with complaints of ocular discomfort. Yet the widely divergent views and teachings regarding many fundamental facts and principles often leave one in doubt as to whether or not there is a rationale which may serve as a guide to the prescription of prisms, orthoptic exercises, and so forth. I am desirous, therefore, of presenting various considerations and data concerning the positive and negative am-

*Submitted for publication October 22, 1934.

plitudes of accommodation and convergence, which I believe will serve as a basis for the intelligent and scientific use of ophthalmic prisms and for such modifications of spherical lenses as will be conducive to the harmonious and efficient coördination of the functions of accommodation and convergence.

PART I

Outline of a Routine in Ocular Refraction

In 1917 I presented in the introductory pages of my book on dynamic ocular tests an outline containing eighteen tests of a static or dynamic character which I believed constituted the essentials or fundamentals of an adequate refractive examination of a pair of eyes. These tests, in large part, are now included in the routine procedures of many practitioners. By reason of the progress which has been made in the last fifteen or twenty years relative to the solution of the problems of accurate and comfortable vision, there have been added, by various writers and investigators, additional tests and refinements in technic which have proved to be of considerable value in refractive procedures. At the present time I believe that the records should contain data concerning:

1. History
2. Ophthalmoscopic and external examinations
3. Ophthalmometric findings
4. Phorias without corrections and also when wearing previously prescribed lenses
5. Static retinoscopy, both monocular and binocular findings
6. Dynamic skiametry at 40 inches and at the usual reading distance of 13 inches by either (or both) the Sheard or Tait method
7. Subjective findings
8. Lateral phorias, wearing prescription for distant vision
9. Vertical phorias and ductions with distant fixation
10. Adduction (positive fusion reserve)
    a. Blur
    b. Break or diplopia
    c. Recovery
11. Abduction (negative fusion reserve)
    Same as in No. 10
12. Phorias at the reading distance
    a. With correcting lenses
    b. Without correcting lenses
13. Cross cylinder findings
14. Adduction (positive fusion reserve)
    a. Blur
    b. Break or diplopia
    c. Recovery

15. Abduction (negative fusion reserve)
    Same as in No. 14
16. Vertical phorias and ductions
17. Amplitudes of accommodation
    Monocular and binocular by various subjective methods
18. Amplitudes of accommodation by objective methods
19. Positive relative amplitudes of accommodation
20. Negative relative amplitudes of accommodation.

To discuss adequately the various technics employed and interpretations made concerning these different tests would be beyond the scope of this essay. Attention will be devoted, therefore to a consideration of some points regarding the analysis and interpretation of data concerning the liabilities (demands) and assets (reserves) of the functions of convergence and accommodation.

PART II

The Function of Convergence

A dual function is performed by eyes that are orthophoric, emmetropic, and not presbyopic when the point of fixation or attention is changed from infinity (6 meters) to, say, a third of a meter. Accommodation is called into play so that the object of regard may be seen clearly or in sharp detail, and convergence is demanded in order that the object under regard may be seen singly.

Prentice rule. The number of prism diopters of convergence required to give binocular single vision may be obtained from the Prentice rule: Read the patient's interpupillary distance in centimeters, then half of it will indicate the prism diopters required to substitute one meter angle for each eye. For example, with orthophoria at distance, binocular single vision is obtained at 33 cm. (13 inches) through the delivery of innervation corresponding to, or optically equivalent to, 19.5 prism diopters if the interpupillary distance is 65 millimeters. Obviously, any amount of genuine exophoria at distance must be added to the amount of convergence needed at any close point of fixation as determined by the Prentice rule and, in turn, any number of prism diopters of esophoria at distance should be subtracted.

Accommodative convergence. Normally, when a pair of eyes, which is emmetropic (or made so by the use of proper refractive corrections) and also orthophoric at distance, converges to or fixes at 13 inches (33 cm.), about two-thirds to three-fourths of the convergence supplied in the act of clear and single binocular vision is associated with the act of accommodation (accommodative convergence) and about a third to a fourth is supplied through supplementary innervation, fusion impulse or desire (fusional convergence).

Accommodative exophoria. Exhaustive tests on the part of several investigators have shown that, at a reading distance arbitrarily chosen as

33 cm., normally about 4 to 8 prism diopters of exophoria are manifest. The condition is classified as an exophoria since it is determined by dissociation methods, the act of accommodation being operative through the reading of letters, and is measured by prisms, base in. The algebraic difference between the total amount of convergence, as measured in prism diopters, according to the Prentice rule (due regard being given to the amount of exophoria or esophoria disclosed under tests at distance) required for binocular single vision at the reading distance and the amount of lateral imbalance disclosed under dissociation tests is a measure of the *accommodative convergence*. If the full complement of convergence is in accompaniment with the act of accommodation, no accommodative exophoria is obtained. If a greater complement of convergence is found in association with accommodation, a condition of accommodative overconvergence is disclosed.

An accommodative exophoria of 4 to 8 prism diopters is found so commonly and consistently in individuals with comfortable vision and adequate visual functions that such an amount of exophoria may be referred to as *physiologic* or normal. In all biologic, physiologic, and psychologic investigations, it is essential that norms be established and that departures from these norms, either as excesses or deficiencies, be considered solely as departures from average or normal standards. Such variations from the normal are not to be classified as pathologic or what not, except in the light of other tests and investigations. For instance, an exophoria of 12 prism diopters disclosed at the 13-inch fixation distance is not to be considered, per se, as abnormal; rather is it to be regarded as a departure from the majority of findings concerning the amount of accommodative exophoria in the nearest normal and most efficiently and comfortably functioning pairs of eyes. Furthermore, such a finding as that which I have cited furnishes evidence of a quantitative character regarding the demand on the fusional convergence in the interests of binocular single vision and indicates that this demand is greater than is ordinarily found. Whether or not this demand can be met with comfort can be judged only on the basis of data concerning the fusional convergences and allied tests.

Accommodative and fusional convergences. Normally, the convergence innervation requisite for binocular single vision is supplied by: (1) the accommodative convergence, or that portion associated with the act of accommodation, and (2) the fusional convergence, or that portion demanded and furnished in addition to that supplied by the accommodative convergence. Therefore, the number of prism diopters of exophoria (accommodative exophoria) disclosed at the reading distance is a measure of the amount of positive fusional convergence which is needed and which must be supplied as a supplement to the accommodative convergence in order that binocular single vision may be obtained. Such fusional convergence is often referred to in the literature as supplementary convergence. When the accommodative exophoria is of large amount, it is obvious that the demand on the positive fusional or supplementary

convergence is correspondingly large. When the accommodative exophoria is normal in amount (about 6 prism diopters), the greater portion of the convergence necessary for binocular single vision is accomplished as an accompaniment of the act of accommodation. When a condition of esophoria maintains at close points, the innervational demands in the interests of binocular single vision must be met and carried by the negative fusional or supplementary convergence.

Positive fusional convergence reserve. The positive fusional (or supplementary) convergence reserve corresponds to that which is designated in the literature as adduction. It seems to me that it would be better if all ductions, either at distant or near points, were referred to as positive and negative fusion reserves. The positive fusion reserve may be measured by a method in which the subject under test fixes and reads a vertical row of letters while prismatic power, base out, is placed before the eyes and increased to an amount which causes the letters on the fixation chart to commence to become blurred. In many instances in the past, various practitioners have continued the insertion of prisms (obtained through the use of rotary prisms or preferably by the use of one rotary prism only placed before the nondominant eye) until diplopia ensued. Quite frequently, and especially in nonpresbyopic eyes, the vertical row of letters appears blurred before it becomes double. This condition may be interpreted as evidence that an accommodation greater than is necessary to see clearly and distinctly is being forced into operation, for, under the incentive of the examiner's repeated request that the row of letters be kept single, there is a stimulus to the maintenance of binocular single vision to the greatest degree possible. The additional accommodation thus brought into play at the time the letters are reported as beginning to blur is normally associated with accommodative convergence.

Fusional reserves, convergence accommodation, and accommodative convergence. It is possible, therefore, that the amount of prismatic power necessary to produce diplopia measures, as a summation, two entirely distinct ocular functions: (1) positive fusional reserve to the point of blur, accommodation remaining constant, and (2) additional accommodative convergence brought into action by reason of the increased accommodation delivered for the maintenance of single (although blurred) binocular vision.

If we designate as accommodative convergence that convergence which is directly associated with the accommodation as it functions to produce distinct vision, we may in turn designate as convergence accommodation that accommodation which is associated with convergence as it functions to maintain binocular single vision when the convergence resources (accommodative convergence, fusional convergence, and positive fusional reserves) have been exceeded and hence are unable to maintain binocular single vision. Therefore, any convergence developed by reason of excessive accommodation should not be considered to be fusional convergence, since it is not available unless excessive accommodation is in force.

Moreover, in some instances in which the convergence (accommodative) in association with the act of accommodation is relatively low, the accommodative exophoria relatively high, and the positive fusional reserve low or of such a value that the ratio between the demand on the positive fusional convergence and the positive fusional reserve is unity or thereabouts, it is possible that binocular single vision may be maintained, in part at least, through convergence accommodation, the eyes refractively being in a state of pseudomyopia, decreased hyperopia, or increased myopia. If such a condition exists, it should be disclosed by data obtained from dissociation tests, positive and negative fusional reserves at distant and near points, the accommodative exophoria or fusional demands, the findings by static and dynamic skiametry, and the positive and negative relative amplitudes of accommodation. In general terms, such cases should receive the proper lenticular corrections, coupled with the incorporation of prisms, base in, together with orthoptic training, and treatment for the development of the fusional desire or faculty.

Blur, diplopia, and recovery data in tests on fusion. An excellent method for obtaining the value of the positive fusion reserve is to determine the maximal amount of prismatic power, base out, which can be overcome by the subject under test, the vertical row of letters remaining both distinct and single. This value of the prismatic power may be considered to be the true positive fusion reserve. Proceed to determine the amount of prism, base out, that can be inserted until diplopia occurs, thus permitting the additional accommodation thereby stimulated to furnish whatever quota of additional convergence is possible. Finally, determine the value of the prismatic power under which the subject under test again "picks up" or reëstablishes binocular single vision, by slowly reducing the amount of prism in the rotary prism units. These procedures afford information concerning (1) the true positive fusional reserve, (2) the total positive convergence reserve, both fusional and accommodative, and (3) the quality of the positive reserve or the desire for binocular single vision.

As an illustration, assume a set of conditions such that, with 24 prism diopters, base out, the line of type is blurred; with 35 prism diopters (or 11 prism diopters more) diplopia ensues, and that distinct binocular single vision is reëstablished when the prismatic power is reduced to 18 prism diopters. The findings may be recorded as 24—35—16.

Various opinions are held regarding both the significance and interpretation of data concerning the prismatic power with blurred vision, diplopia, and reëstablished single vision. Since the dissociation tests at the reading distance involve accommodative action, whenever possible, to the amount necessary for clear and distinct vision but under a suppression of binocular single vision, and since these dissociation tests are made in order that the amount of accommodative exophoria or esophoria (accommodative overconvergence) may be determined as a measure of the deficiency that must be supplied by the positive or negative fusional

convergence, respectively, it is my opinion that the determination of the true fusional convergences is the most essential and of the greatest significance. In the case of presbyopes, or in those who demonstrate subnormal accommodation, the addition of sufficient plus (convex) lens power to enable clear vision to be maintained at the reading distance permits the examiner to obtain these valuable data. We have reason to believe that the innervational demand, for example, of three diopters of accommodation when reading at 13 inches is supplied normally in presbyopes, but that the resultant lenticular changes and accommodative act are not accomplished. Statistical data indicate that the accommodative convergence in presbyopes wearing proper presbyopic corrections is, in general, not as great as in younger subjects. In presbyopic cases, therefore, the values of prismatic power producing blur and diplopia are likely to be nearly the same. And, morever, as has been tritely expressed, the esophore of youth often becomes the exophore of advanced years. Hence in presbyopia there is a normal expectancy that the amount of prismatic power necessary for the reëstablishment of binocular single vision will be high.

Negative fusional convergence reserve. The negative fusional reserve corresponds to the abduction tests as determined with fixation at infinity. The accommodation, except in cases of presbyopia, is in action to the number of diopters requisite for distinct vision at the distance chosen for the close test. A vertical row of letters is used as the test object and the subject is instructed to maintain distinctness and singleness of vision while prismatic power, base in, is placed before the eyes in increasing amounts through the use of rotary prism units. Through the determination of the amounts of prismatic power, base in, required to give single but blurred vision, diplopia, and reëstablished binocular single vision, respectively, the examiner obtains information regarding the development of, and desire for, binocular single vision, as well as a quantification of the inhibition of accommodation (indicated by the difference in prismatic power requisite for blur and diplopia) which is evidenced by the relaxation of the accommodative convergence that is associated with the function of accommodation. The difference in the amounts of prismatic power necessary initially for blurred vision and finally for diplopia may be considered to be a measure of or evaluation of the divergence accommodation. That is to say, it may be regarded as an estimate of the additional divergence which may be elicited under test, by virtue of the ability to maintain binocular single vision, although indistinct and blurred, through the relaxation of, or inhibition to, accommodation.

If, for example, the line of type begins to blur with 15 prism diopters, base in, and if diplopia occurs with 20 prism diopters, and reëstablished binocular single vision is obtained with 16 prism diopters, we should record the findings as 15—20—16. These data indicate that there is a well-developed fusion. If, on the other hand, blurring occurs with 12 prism diopters, base in, with diplopia at 23 prism diopters, and recovery of binocular single vision at 6 prism diopters, there is evidence of a low-grade desire for single vision or an undeveloped fusion. This

analysis may be substantiated further by the data relative to accommodative convergence, fusional requirements for singleness of vision, and the relative positive and negative amplitudes of accommodation.

In general, therefore, since the excess or deficit of accommodative convergence must be compensated by the fusional convergences, and since it may be assumed as an established principle that the functions of either the positive or negative fusional convergence cannot be called into operation, if ocular discomfort is not to be experienced, in excess of a fourth to a third of their total values, it is of the greatest importance that adequate data be obtained regarding the demands upon and the reserves of fusional convergence.

Fusional requirements and fusional reserves. The great ocular problem from the standpoint of comfort is the economic and efficient coördination of accommodation and convergence. In general, no more than a third of the total fusional convergence and not in excess of two-thirds of the accommodation available should be operative if distinct binocular single vision is to be obtained and maintained with comfort.

If the total positive fusional convergence (which is the sum of the accommodative exophoria and the positive fusion reserve obtained by the use of prisms, base out) is 30 prism diopters, the innervational requirement (determined by the amount of accommodative exophoria) should not exceed 10 prism diopters. Or, in other words, the fusional requirement or demand should not exceed 10 prism diopters if the positive fusional reserve is 20 prism diopters. The ratio between fusional demand and fusional reserve is 10 to 20 or 1 to 2. The ratio between fusional demand and total positive fusional convergence is 10 to 30 or 1 to 3. In a case of this character, which may be classified as a border-line condition, if ocular discomfort existed and if other findings and data indicated that the lenticular corrections prescribed should have adequately taken care of refractive errors and accommodative requirements, orthoptic training and treatment should be instituted to develop the positive fusional reserve and, as a temporary expedient at least, 2 to 3 prism diopters, base in, should be incorporated in the reading corrections.

And, again, assume that under test there is evidenced an accommodative exophoria of 5 prism diopters and a positive fusional reserve of 25 prism diopters. The demand on the positive fusional convergence to enable binocular single vision to take place is 5 prism diopters. Since the fusional reserve is 25 prism diopters, the total positive fusional convergence is 30 prism diopters. I believe that such a pair of eyes should be comfortable from the standpoint of the demand on and reserves of convergence, since the ratio between demand and reserve is 5 to 25 or 1 to 5, and the ratio between demand and total positive fusional convergence is 5 to 30 or 1 to 6. On the other hand, if the fusional requirement or demand should be 15 prism diopters and the total positive fusional convergence was 30 prism diopters, thereby indicating a positive fusional reserve of 15 prism diopters, it would be the normal expectancy that

ocular discomfort would be experienced when the eyes were engaged in reading and other close work.

Illustrative data. These considerations may be augmented further by the presentation of three sets of data which, in essentials, are obtained frequently in routine ocular refraction, the tests being made at a fixation distance of 33 cm. (13 inches). An interpupillary distance of 60 mm. is assumed in all cases.

TABLE 1

Data on Fusional Requirements and Fusional Reserves in Selected Types of Cases

Tests	Case 1	Case 2	Case 3	Case 4
1. Tonic convergence	0	4	3	2
Dissociation tests at distance	orthophoria	exophoria	esophoria	esophoria
2. Convergence required for binocular single vision at 33 cm. if orthophoric under distant fixation	18	18	18	18
3. Convergence used at 33 cm. (algebraically add values given for tests 1 and 2)	18	22	15	16
4. Accommodative exophoria or fusional convergence demanded	5	14	0	3 excess
5. Accommodative convergence (algebraically subtract values given by tests 3 and 4)	13	8	15	19
6. Positive fusional reserve or true adduction at 33 cm.	20	16	30	35
7. Negative fusional reserve or true abduction at 33 cm.	16	28	12	10
8. Total positive convergence amplitude (algebraically add values given by tests 4 and 6)	25	30	30	32

In case 1 (Table 1), the convergence requirements for binocular single vision are distributed most advantageously, as judged on the basis of the results of several independent researches on the nearest normal and most comfortably functioning pairs of eyes, between accommodative and fusional convergences, with ample fusional reserves, and a relatively low fusional demand. The ratio between fusional demand and fusional reserve is 5 to 20 or 1 to 4.

In case 2 the fusional demand is 14 prism diopters and the fusional reserve is 16 prism diopters or a ratio of practically 1 to 1. The probability is that there is an insufficiency of total positive fusional convergence adequately to take care of the fusional demand and accomplish the act of binocular single vision with comfort. In general, in this type of case, incorporation of prisms, base in, and prismatic and other exercises for the development of fusional reserves, are indicated.

In case 3 all of the convergence requisite for binocular single vision is accommodative in character. The positive fusional demand is nil, and the positive and negative fusional reserves are relatively high in value.

In general, such findings are indicative of latency of hyperopia, spasms of accommodation or insufficiency and inadequacy of accommodation, and fundamentally require maximal amounts of convex lens power or minimal amounts of concave lens power in order to inhibit an overstimulated accommodation or adequately to care for the accommodative requirements. Some writers and practitioners advocate the use of prisms, base in, in this type of case, as an aid in the suppression or inhibition of convergence and as a preliminary procedure before prescribing the maximal convex or minimal concave lenses which can be tolerated. Another method of procedure is to prescribe two pairs of glasses, or bifocals.

Accommodative overconvergence is indicated very definitely in case 4. The negative fusional demand is 3 prism diopters and the negative fusional reserve is 10 prism diopters. The ratio of negative fusional demand to negative fusional reserve is 3 to 10 or practically 1 to 3. The esophoric condition or state of overconvergence is presumably of an innervational and not of an anatomic character. The procedures briefly outlined in connection with case 3 should be followed. The prescription of prisms, base out, in such cases is permissible and may be necessary if proofs indicate that the condition of overconvergence is due to anatomic rather than innervational causes. As I have stated elsewhere, I believe that the incorporation of prisms, base out, in the prescription of lenses to be worn permanently is rarely indicated or necessary. On the other hand, I am not convinced that the indiscriminate use of prisms, base in, is of value on the basis that base-in prisms will hasten orthophoria. It is possible that a rationale for the amount of prism, base in, that may be prescribed in the interest of inhibiting convergence must be based on, and limited by, the amount of abduction which is disclosed under test. In general, proper lenticular corrections should be given together with orthoptic training to develop the negative fusional convergence (abduction).

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OCULAR INVOLVEMENTS FROM VENEREAL DISEASES*

W. Gasson, F.B.O.A., F.S.M.C.
Fellow of the Physical Society

Assistant Refractionist to the London Refraction Hospital
Watford, Herts, England

PREFACE

A comprehensive textbook, dealing with the venereal diseases of the eye, in their entirety, is found wanting. There are numerous books dealing with both the Ocular and Venereal diseases in general, but there does not seem to be one written on this subject exclusively. Venereal diseases are the original source of many ocular conditions, this fact being further emphasized when we realize the prevalence and widespread nature of these social scourges. Over 65,000 lives are damaged every year in England and Wales. Many writers do not consider the subject of sufficient importance to merit this exclusive treatment. The present writer disagrees with this assertion. Statistics, as given in this paper, prove his contention. It would probably be no exaggeration to state that the majority of the members of the optical profession have met cases of venereal infection of the eyes and have forwarded them on to the proper quarter for adequate treatment.

Superficial consideration of the ocular diseases has been given. A wider and more intensive study of them can easily be afforded in the usual textbooks dealing with them as their proper subject matter. No mention of the medical treatments has been given to the venereal diseases themselves, as this is not in our province and does not concern us. Who has not heard of the use of Mercury compounds and of Salvarsan, more commonly known as "606"?* The outcome of this paper was due to the writer encountering several cases in the course of his work. When the writer wished to study this subject no standard textbooks were forthcoming. Since apparently none have been written on this subject (as far as the writer is aware), up to the present, in its entirety, except for isolated papers, this paper is the result of an intensive study. Moreover, the writer does not claim to have dealt with the subject authoritatively.

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Introduction

Three drugs are known to influence Syphilis in a remarkable manner: Mercury, Iodine, and Arsenic. Arsenic is adopted universally. There are many preparations in use, the result of the intense labor, and tireless investigation of Ehrlich (1858-1915). In 1910, with the able assistance of his Japanese colleague, Hata, they stumbled upon the proper chemical constitution of the requisite arsenical compound, known as SALVARSAN (Latin: Salvere, to heal, and Arsenic), or "606." This is the abbreviation of Dioxy-diamido-arsenobenzol [$(NH_2)OH\text{-}C_6H_3\text{-}As\text{:}\ As\ C_6H_3\ (OH)\ (NH)\ (CH_2O)\ SONa$]. This compound being the 606th preparation of the Amido group of Phenylarsenions acid. Its German name is Ehrlich-Hata-Mittel. There are two other arsenical preparations in use, viz.: Neo-Salvarsan or Novarsenobenzol, which is less toxic than Salvarsan, known as "914," and arseno-phenylglycia, known as "418."

The sex factor, in its manifold manifestations, is so interwoven into the human existence, that any observer, whether layman or scientist, must needs approach the study with awakened enthusiasm. When the mind becomes involved with the personal and sociological problems that are centered around the sex factor, then both curiosity and wonder are stimulated in their turn. To a corresponding extent, morality must center itself around the steps that are taken to regulate the primeval urge. So severe and uncompromising are the motives which have repressed the illicit forms of love, that the penalties incurred by the occasional violation seem almost natural and to be expected. The frustration of the sexual impulses demanded by our present civilization, is easy to comprehend if we devote a little introspection to, and observation of the subject. The psycho-analytical revelations concerning sexual repression have aroused more opposition than any other of its discoveries.

A social disease such as Syphilis or Gonorrhea, which is shrouded in obscurity, finds its soil most fertile, because no one will discuss it rationally, and no personal steps are taken to prevent its spread. It flourishes like a poisoned fungus with alarming and, perhaps, fatal rapidity. The policy of negation and silence is one of the contributory causes of this widespread scourge. The social stigma created by the inherited or acquired form, particularly the latter, further increases its potency, as the unfortunate victims often wish to cover up their disgrace and misfortune. We would not under-estimate the virulence of venereal diseases, if we realized that they are responsible for more deaths than are cancer and consumption put together. They are responsible, directly and indirectly, for more devastation, sorrow, and misfortune than any other pathological condition. They are the chief contributory causes for premature old age, crippling, ill health and death, with which preventive medicine has to deal.

Origin and History

The origin of Syphilis is shrouded in mystery and imagination, and many historians do not agree as to the actual date and manner of its introduction into Europe. It is said that over 5,000 years ago the Chinese were acquained with Venereal Utheritis, and in the days of Moses the disease was of sufficient importance for him to lay down definite instructions for those infected with urethral discharge. Galen, (Claudius Galenus) a Greek physician, A. D. 130-A. D. 201, does not

give any account of the disease of Syphilis, which illustrates the fact that it was probably unknown in his time in Rome. In the writings of Rhazes, another celebrated Persian physician, A. D. 850-A. D. 932, suggestions of this disease are found. It is common knowledge that there was a great outbreak of Syphilis in Naples during the year 1494, and that there were numerous recurrences in Europe during the following two years. Many writers attributed the introduction of Syphilis into Europe by Columbus, who was supposed to have imported it from the West Indies, which he discovered in 1492, on his return to Europe in 1493. Other authorities are led to believe that Syphilis appeared in Asia Minor about the beginning of the Tenth Century, spreading gradually eastwards and westwards, reaching into Europe about the end of the Twelfth Century, probably along the great Trade Routes, up the Adriatic coast and so into Venice. Other investigators consider that the Crusades, which were in progress during the Eleventh, Twelfth and Thirteenth Centuries, were a means of its conveyance into Europe. It is believed to have increased in virulence, reaching its climax at the end of the Fifteenth Century. Some historians believe that Henry VIII died as a result of syphilitic infection, and his daughter, Mary, suffered from congenital syphilis as well. It is also suspected that as she suffered from her eyes, she was afflicted with Interstitial Keratitis.

There is no concrete evidence that the diseases mentioned in the Bible were syphilitic, although in Leviticus, Gonorrhea is described, and evidence suggests that it was known in remote times. In the time of Christ, blindness was a common affliction. "Did this man sin, or his father, that he was born blind?" Infantile blindness is frequently gonococcal in origin. The history of venereal diseases especially that of its major member, Syphilis, is one of the most difficult sections in medical history. There is no evidence of Syphilis prior to the Tenth Century, yet during the Fifteenth and Sixteenth Centuries numerous and widespread attacks occurred.

THE NATURE OF VENEREAL DISEASES

Part I

The word "Venereal" is associated with Venus, the Goddess of Love. Venereal diseases are those which in most instances, are acquired by promiscuous sexual intercourse. There are two major venereal diseases, viz.: Syphilis and Gonorrhea, which are highly contagious, besides several other minor diseases. In matters of health and general well-being, there are few questions that are of greater importance than venereal disease. The venereal infection is not instantaneous, as the causative organisms take, sometimes, perhaps a few hours, before they are inaccessible to the effective action of antiseptics. For a short time, these organisms can be destroyed whilst they are on or near the surface, and before they have multiplied to any large extent. Venereal diseases are chiefly spread by sexual intercourse, as non-sexual venereal disease is

rather uncommon. Moreover, non-sexual syphilis can be acquired by kissing, using an infected razor or shaving brush, infected handkerchiefs or cigarettes, etc., or even from a public drinking fountain. Physicians or surgeons can acquire the disease in the course of their work, or a child can acquire either Syphilis or Gonorrhea from either of its parents. The venereal organisms are quickly killed by exposure and rapidly succumb to the effective use of antiseptics. This probably accounts for the relative infrequency of extra-genital infection.

Venereal diseases are, in actual reality, parasitic diseases. There are many parasitic organisms other than the venereal, which seriously affect the human eye, such as the Koch-Weeks Bacillus, the Staphylococcus, and the Pneumocococcus, etc. The syphilitic parasite is an animal parasite, an unicellular protozoan organism, resembling a spirillum. The gonorrheal organism is a vegetable type and is, in reality, of bacterial origin. The organism found in soft-sores, one of the minor venereal diseases, is an unclassified bacillus. The inherent difference between the nature of the Syphilitic and Gonorrheal parasite is probably the reason why the former is considered to be the more virulent of the two, although the gonorrheal organism is a very potent organism.

The name "Syphilis" comes from the name of the hero of a poem written in 1536, by an Italian doctor named Fracastorius, and ever since its appearance—Syphilis was the name of the gentleman—it has been the name given to this disease. It is also known as the Bad Disorder, the Pox and the Great Pox. The term "Gonorrhea," also known as the Clap, is derived from two Greek words, meaning a "flow of seed." We are aware, however, that the "matter" that is referred to is not seed, but a purulent discharge. (Gonorrhoia; γονορ-ρεεἰν; gonos-seed, rheein—to flow)

Syphilis

This protean disease manifests itself in many forms, both structural and functional, not only in the victim but possibly also in his children. This highly contagious disease is caused by an organism known as the Spirochaeta Pallida, or the Treponema Pallidum. This is a germ resembling a tiny spiral thread, twisted like a corkscrew about 10-15 ($1u = .001$ . . or $1u = 10^3$.) in length. This was discovered by Schaudin and Hoffman in 1905. The Spirochiaeta Pallida is made up of about eight or ten or even more close set curves with sharp ends. These facts are extremely important as there are several other Spirochaetes somewhat similar in appearance, which are frequently found in many types of ulcers. Another very common type of Spirochaete, is the Spirochaete Refringens, in which the curves are wider, and less numerous, there being only about three or four. Moreover, the staining reactions are dissimilar. Hence, valuable clinical evidence is afforded by means of this differentiation.

This disease, in its beginnings, shows at the site of infection, a peculiar hard sore, or more commonly known as the Primary Sore, or

Hunterian Chancre. The Spirochaete is communicated by contact with an infected surface, either directly or indirectly. The situation is usually on the genitalia, but may be situated in almost any other area where an abrasion is likely to be infected with the virus.

Syphilis, at its commencement, is generally, particularly in the male, outside the body on the surface of the skin or mucous membrane, as the case may be. In the female, however, it is often out of sight, owing to its origin, but even then, for our present purpose, it may be considered as being on the surface. Whereas in the case of Gonorrhea, the disease generally attacks the individual in the Genito-Urinary tract, in other words, inside the body. Syphilis is a chronic disease, whereas Gonorrhea may be considered to be acute. The time when the first symptoms appear is about four weeks after the date of infection. This latent interval is known as the incubation period. No signs can be detected until after this period has elapsed.

Some six weeks or so after the primary sore or Hunterian Chancre has appeared, the secondary symptoms begin to develop, providing that the victim is not being treated in the meantime, during the first stage. There is, at this stage, a general enlargement of the lymphatic glands, and a faint red rash is usually seen on the front of the chest. Iritis may occur at this stage, and this secondary period lasts for about two years in untreated cases. Afterwards, this secondary stage gradually fades into a tertiary stage, which may or may not last for the remainder of the patient's life.

At this stage, gummata may occur anywhere in the body, including various parts of the eye. This gumma is a peculiar form of tumor also known as a Syphilioma, and can be of various sizes, even as large as a hen's egg. These gummatous formations are soft elastic tumours and are found to contain the syphilitic organism, the Treponema Pallidum. When a gumma forms in the brain, an operation to relieve pressure and perhaps to save vision is often necessary in the course of treatment.

The final and most distressing stage in the course of the disease is the parasyphilitic or quaternary stage. The symptoms are chiefly confined to the brain and spinal chord. The chief disease is Tabes or Locomotor Ataxia. General paralysis of the insane may occur at this stage of the disease. In all these conditions, and in all the four stages of Syphilis, the eye or its appendages may be involved.

Syphilis can be compared to Tuberculosis being both microbic diseases. The Spirochaeta Pallida, as a matter of fact, belongs to the family of Trypanosomes, which have furnished the parasite of Dourine, a disease of horses, which is, in many respects, analogous to Syphilis. This equine parasite is known as the Trypanosoma Equiperdum. Although certain of the lesions of Syphilis are in many respects similar to those of Tuberculosis, the two diseases are very different in their epidemiological point of view, and also as regards the modes of contagion and infection.

Congenital Syphilis

In the congenital form of Syphilis, certain indications are present, which can indicate to the observant and initiated the presence of the disease. The most characteristic is the condition known as Hutchinson's Teeth. The upper central incisors of the permanent set have a notch cut out of the center of the biting edge. This is absolutely characteristic. There are other visible facial signs, such as a marked depressed bridge of the nose, a saddle bridged nose, known as "frog-nose." This is caused by a gradual necrosis of the bones, causing the bridge of the nose to give way. At the sides of the mouth fine cicatrices may be observed. These cicatrices may also be found in the mouth and pharynx. A cleft palate is generally an indication of a syphilitic inheritance.

Heredito-syphilis is the transmission of the infective microbes from one of the parents to the child. The morphological modification of the offspring which in this case presents degenerative changes, is of a dystrophic type, and not of an infectious nature. These degenerative changes constitute the general stigmata of syphilitic inheritance. They are varied and many, manifesting themselves throughout several generations, and may affect any part of the system. The most serious of these hereditary taints is the creation of an organic soil which is ideally suited for the development of tuberculosis. The microbe of the disease may pass from the procreator into the child, through direct infection of either of the reproductive cells, the ovum or the spermatozoon or when the inheritance is of maternal origin, the microbe may pass through the placenta. In this case the child enters the world a victim of the same disease as its infected parent.

Congenital Syphilis is very similar to the acquired disease which has dodged the primary stage. It is usually observed in the secondary stages, sometimes in the Tertiary stage, when it will not, of course, be present in the child. Congenital Syphilis may, however, be considered synonymously with hereditary syphilis.

The Wasserman Test

Whenever there is any doubt as to the detection of a syphilitic taint, evidence may be obtained from a test known after its discoverer as a Wasserman Test. This is a blood test discovered in 1906 by August von Wasserman. A small quantity of blood is allowed to clot in a test tube. The clear serum that is formed is drawn off, and added to various chemical reagents. By varying the amounts of serum used, quantitative tests can be carried out. Cerebro-spinal fluid may be used in place of the blood serum.

The Wasserman test has now attained enormous importance in the diagnosis of Syphilis. It is a blood test that is very reliable and trustworthy, which can be applied even when there is no material evidence

in the form of localized Spirochaetic infection. The theory of the reaction is extremely complicated and is difficult to understand by those who are not initiated with the subject of immunity. The basis of the whole test is dependent on the phenomenon known as haemolysis.

The diagnostic value of the Wasserman reaction varies with the stage of the disease. It does not become positive until about six weeks or so after the initial infection, so that a negative Wasserman test within two months, does not exclude the possibility of Syphilis, and only consistent negative reactions show that the disease has been cured.

Gonorrhea

This specific contagious disease is marked in its early stages, and a few days after infection, by a purulent discharge from the primary site of infection, which is generally situated in the genital region. Not uncommonly, are the eyes as well as other parts of the body the area involved. The actual symptoms vary according to the age and sex of the patient in question, but they are all characterized by this mucopurulent discharge. This disease is caused by an organism known as the Gonococcus, which is a diplococcus, shaped somewhat like a kidney-bean, varying between .8-1.6u in length. They generally appear in groups of four and are found within the cells of the discharge. This causative organism was first discovered by Neisser in 1879. Both the Spirochaeta Pallida and the Gonococcus are always present in the diseases to which they give rise, and all persons are likely to be infected from them. There seems to be no congenital immunity against venereal diseases. Both types are endemic in the civilized world, and only a few remote uncivilized tribes have escaped infection by them.

Gonorrhea invades the system through the mucous membrane, and probably never through the skin, nor even through a cut or scratch in the surface of the skin. This may be noted in contradistinction to that of its fellow disease—Syphilis. An exception to this is the conjunctiva, for here a very severe inflammation results from gonococcal infection. The gonococcus seems to enjoy a great affinity for the conjunctival surface of the eye. In the beginning, the disease is acute and gives rise to a considerable and rapid reaction to the surrounding tissues. This reaction is shown by the severe pain and purulent discharge, which is composed of dead tissue and dead blood cells.

The usual means of infection is during sexual intercourse, although the disease may be contracted by other and more innocent means, such as through face towels, handkerchiefs, sponges, underclothing, etc. Gonorrhea is more common than Syphilis, and is commonly, though perhaps erroneously, supposed to be less malignant. Gonorrhea may lead to disastrous results, especially in women, if treatment is neglected, and is a common cause of sterility. It is calculated by reputable authorities that this disease is responsible for approximately 20 per cent of the

total blindness in the world today. The disease of the eyes is obtained during actual birth and is known as Ophthalmia Neonatorum.

The Minor Venereal Diseases

These diseases are nevertheless very important, and it is necessary to differentiate them from the two major diseases. Soft-sore, Herpes or Shingles, Fungus or Ringworm, Pediculosis or Lice, and Scabies or Itch are often associated with the same causations as those of the major forms. These may be obtained, except for the condition of Soft-sore, by innocent means, other than through licentiousness. Soft-sore in particular may involve the eye or its appendages.

Soft-sore

Soft-sore or Soft Chancre, is the name given to distinguish it from the hard sore of primary syphilis. It, too, is usually located in the genital regions, although it may be found elsewhere, including the eye, by accidental contamination. The Soft-sore is due to an organism known as Ducrey's Strepto-Bacillus. These bacilli are short, straight rods about 1.5u in length, with rounded ends, and are found to exist in pairs or in a chain formation. The incubation period is generally less than a week, forming a useful means of distinguishing it from the hard chancre of syphilis, which seldom appears less than a month after infection. A soft chancre is generally painful although the hard syphilitic chancre of syphilis is not usually the case. It is extremely important that in diagnosing a soft chancre not to exclude the possibility of the existence of a latent syphilitic infection. It may, however, have the organisms of syphilis mixed up with it, and then it is considered to be what is termed a mixed infection. It cannot be too strongly emphasized that both types of chancres, the soft and the hard, are intensely infectious, and that stringent precautions must always be observed. A soft chancre is sometimes multiple, and both types, the soft and the hard, lead to an extensive destruction of the neighboring tissues.

Herpes

Herpes Ophthalmicus, Herpes Febrilis and Herpes Corneae are forms of the disease which lead to ocular involvement. In this disease, vesicles are left over the face, or scars of these vesicles remain. Sometimes the disease may be mistaken for Erysipelas. These vesicles, when not localized, on the genital organs, may not, of course, be venereal in origin, and even when situated there, they may not be due to promiscuity. These vesicles may cover a greater or lesser area, and dry up, healing by scabbing. In Herpes Ophthalmicus, the ophthalmic division of the (fifth) Trigeninal nerve is involved. In Herpes Febrilis, which is associated with some febrile disease, such as pneumonia or influenza, the cornea is affected. These vesicles are about as large as a pin's head, and arranged in group formation. Herpes Corneae is often found with this condition, which can be msitaken for Phlyctenular Keratitis.

Part 2.

OCULAR MANIFESTATIONS IN SYPHILIS

A. Acquired. An investigator, named Santos Fernandez, offers a striking analysis of the incidence of Syphilis, among the cases of ocular disease treated in the Eye Clinic in Havana. During a period of 39 years, out of a grand total of 50,250 cases that were treated, 16,697 were due to syphilis; of this number, there were 978 cases of Iritis, 547 cases in which there were fundus lesions; 142 cases of paralysis of the ocular muscles; and 30 cases in which the lids or the orbit were involved.

Fournier, a celebrated French Syphilographer, in an examination of 4,700 cases of tertiary syphilis, found 111 cases of direct ocular infection, and 2,009 cases of involvements of the brain and spinal cord, which themselves may lead to involvements of the eyes themselves. Many other cases in this same investigation more than probably had ramifications leading to affections of the eyes, or their appendages.

Syphilis, in all its stages, may involve the eye during its course, depending much upon the virulence of the general infection at the time the eye is being involved. The Uveal Tract is the favorite seat of infection in the acquired form, and Iritis, Cyclitis, Retinitis, Choroiditis, etc., are some of its general manifestations. Syphilis does not often produce total blindness, in either or both eyes, providing treatment is undergone, but the percentage of blindness directly or indirectly due to Syphilitic infection, varies according to the locality and type of specific disease. Many authorities do not agree a fairly definite proportion. Margus found 2.2 per cent blindness due to Syphilis, while Alexander in Germany estimated the value at 2.16 per cent due to this cause, although this shows close agreement.

Primary Syphilis

The initial lesion is sometimes found on some part of the eye or its appendages; this area is relatively a frequent source of the primary infection. Hard Chancres have been found on the eyelids, particularly the lower lid upon the palpebral conjunctiva, and even upon the cornea itself. The infection is often the result of contact from infected fingers. These Hunterian Chancres may perhaps be confused with Epithelial cancer, making it necessary to await the secondary stages before definite clinical evidence can be ascertained as to the nature of the specific disease.

This primary lesion is found in about 5 per cent of all cases of extra-genital chancres. The most frequent ocular chancres are, in order of the conjunctiva, of the lower lid, and the margin of the lower eye-lid. Next in order of frequency, come the inner canthus, and the upper eye-lid, and the least frequent of all, is the cutaneous surface of the eye-lids. A hard chancre of the conjunctiva is a very malignant looking ulcer. There is an early enlargement of the pre-auricular and post-cervical lym-

phatic glands if the primary sore is near the outer canthus. The submaxillary glands are most affected if the chancre is near to the inner canthus. This initial lesion is very similar in appearance to a carcinoma or epithelioma, but can be distinguished from them owing to the rapidity of their growth.

Secondary Syphilis

This stage of the disease rarely affects the conjunctiva or lids, although mucous patches have been observed at the canthi, especially in infants, and sometimes conjuntival ulceration may ensue. The eruptions may affect the skin of the eye-lids, causing a loss of eyelashes, for in the late secondary stages a gumma of the Tarsus may be found.

The Uveal Tract is most frequently involved at this stage of the disease. The iritic and choroidal lesions are probably of similar nature as those of the skin. If rust-colored nodules are located on the iris, the diagnosis of syphilitic iritis can be made. These little nodules which are about the size of a pin's head, are generally found at the edge of the pupil, and sometimes at the ciliary border. Syphilitic Iritis has been noted as early as the third month after infection. Generally the disease is manifest during the first year. These vascular nodules are not gummata as they do not break down or suppurate. Posterior synechiae may be followed by further complications, and these are often observed. Many authorities do not agree as to the frequency of iritis in syphilis, but this ocular disease is a definite manifestation of the general infection. The inflammation is usually plastic, affecting both eyes. Some place the value as low as 0.42 per cent, while others at 5.37 per cent, but some consider the value being between 15-20 per cent. Alexander in his investigations placed the value in the neighborhood of 30-60 per cent of the proportion of Iritis in Syphilis. The syphilitic lesions of the ciliary body may attain great size, sometimes causing a perforation of the sclerotic.

Owing to the intimate inter-relationship between the choroid and retina, and their proximity to the vitreous, we may find an extensive inflammation in one area, involving the others to a lesser degree. The choroid is affected by localized patches of round cell infiltration, especially in the capillary layer. The adjacent retina is often involved, causing a chorio-retinitis. In this disease a diffuse cloudiness of the vitreous is present. Isolated large and small spots of exudate occur in the choroid. The retina appears hazy, owing to the oedema present, and retinal hæmorrhages may be observed. In disseminated choroiditis, there is a development of foci of exudation spread over the fundus, taking form of patches generally about as large as the disc. In the early part of the acute stage, the circular patches of exudation appear, generally at the perifery of the fundus. These spots multiply in number if not interfered with. The retina may be a secondary infection from the choroid, but the spirochaeta pallida may be primarily deposited in the retina itself.

When the lesion is situated in the retina directly it is usually located near to the optic disc. where it is most vascular, and the papilla is usually involved, setting up a neuro-retinitis. As the disease progresses there are disturbances in the pigment epithelial layer, and a varied assortment of ophthalmoscopic pictures can be seen, some resembling retinitis pigmentosa. Dust-like opacities in the vitreous may also be observed. Visual disturbances, such as micropsia, may be present at this stage of the disease.

Syphilis is also a cause of optic neuritis. When the papillitis is accompanied by a perivascularitis, numerous hæmorrhages and exudates, especially if these changes seem to involve the retina itself, syphilis should be suspected. All degrees of papillitis may be resultant from syphilis. The optic nerve may be involved along its whole course, or only a portion may be the site of the inflammation. Syphilitic optic neuritis usually extends to the retina. The disease may be acute or chronic. It may commence quite suddenly, reaching its maximum development in a few days, or it may come on quite gradually, usually attended by a progressive diminution of vision. The optic-neuritis may be caused by acquired or the inherited syphilis. An investigator, named Neumann, has shown that 81.9 per cent of children suffering from congenital syphilis have optic neuritis. Two other workers, named Mohr and Beck, found 62 cases of optic neuritis out of 128 infants under the age of eighteen months, and consider it of great diagnostic value in the detection of congenital syphilis.

Syphilitic involvements of the extrinsic ocular muscles of the eye may also result owing to involvements of the brain. This disease is by far the most frequent cause of paralysis of both the extra and intra-ocular muscles, including tabes; it is considered to be the ætiological factor in about 75 per cent of all cases, while Alexander attributes 59.4 per cent to this cause. When the intra-ocular muscles are involved the condition is usually unilateral, though occasionally it may be bilateral.

Tertiary Syphilis

This stage of the disease does not often involve the conjunctiva or lids, although gummatous ulcers of the lids have been observed. Gummata of the lids are perhaps the most common of the syphilitic palpebral diseases. The eye-lid becomes swollen and tense, and severe ulceration follows, due to the proliferation of the endothelium of the blood vessels. Gummata must be differentiated from a rodent ulcer, as the latter only occurs in elderly people and its growth is very slow. Syphilitic involvement of the lacrymal gland is rather unusual, although a gummatous infiltration has been observed. The crystalline lens is hardly ever affected as a result of syphilis, but these subjects seem to be more prone to cataract.

The cornea is affected by a gummatous infiltration, occurring as a rule in children: the subject of congenital syphilis. This condition is

known as the Interstitial Keratitis. Another cause for opacification of the cornea is the destruction of the enthothetial layer backing on to Descemet's membrane. This is associated with punctate keratitis. Other complications may arise associated with irido-cyclitis. The histological changes found in interstitial keratitis are definitely gummatous in character. There is an infiltration of the deeper cornea layers with round cells, and alongside of these may be found epithelioid and giant cells.

Iritic gummata are sometimes noted, and they are usually found near the root of the iris. Gummata of the ciliary body may occur, and may in their turn involve the sclerotic. They are not very common, but when present, develop rapidly, reaching an appreciable size in a few days, even less than a week. Severe neuralgic pains are complained of, and there is usually a sero-purulent exudation. The affection is usually monocular, and is seen more frequently in acquired syphilis than in the hereditary disease. Gumma of the choroid are rare, except as involvements from the ciliary region or from the optic nerve. Syphilitic involvement of the sclerotic is rather unusual, but when it is observed, the gumma is usually found in the anterior portion. A gumma of the sclerotic seems at first like a small nodule which grows rapidly. The base of this nodule is red, and the congestion spreads into the neighboring tissue. Destruction of the eye may follow. Gummata of the orbit affects the periosteum. Gummata of the optic nerve may occur in conjunction with meningitis. In the case of an orbital gumma, the disease commences in the deeper layers, and as the growth continues, it undergoes necrosis, and a yellow fluid is formed within it. A gumma situated in the neighborhood of the optic foramen shows signs of pressure upon the optic nerve, perhaps causing a central scotoma, and later signs of an intra-orbital tumour.

Quaternary Syphilis

In this stage of the disease, where tabes is the result, the Argyll-Robertson pupil may be observed. This is a pupil whose light reaction is lost, although still possessing the accommodative reflex. The pupils in this condition are generally small owing to spinal miosis. The frequency with which optic atrophy occurs in connection with tabes has been differently estimated by various observers. This condition is found in about 30 per cent of cases of tabes. Other investigators have found 38 per cent cases of Argyll-Robertson pupil in cases of Neuro-Syphilis, from whence they considered it an infallible sign of Syphilis of the nervous system. It is an early rather than a late symptom of the disease.

Some authorities mention nystagmus as a symptom of this stage of the disease.

In cases of atrophy of the optic nerve, the condition is usually bilateral, although it may be more advanced in one eye than in its fellow. As the atrophy advances there is a concentric contraction of the visual fields, although the central vision may remain good for some-

time. Color blindness is not an infrequent result of optic atrophy. Syphilis is also a cause of intra-cranial aneurism which gives the resulting clinical evidence, consisting of pulsating exophthalmos, oedema of the eye-lids, conjunctiva and cornea, accompanied by a complete or partial ophthalmoplegia on the affected side.

Atrophy of the optic nerve may also occur in the early stages of generaly paralysis of the jueane, and may precede the mental disturbances. The atrophy is however a late symptom in most cases. It is not of frequent occurrence, and Gudden found only 4.9 per cent of a series of 1,386 cases. Pupillary anomalies may also be observed. Ekkage describes in some detail two cases (British Journal of Physiological Optics, vol. VIII, part I, pps. 44-45). Among 500 cases an investigator named Moeli, found reflex agidity in 47 per cent, a doubtful reaction in 4 per cent and a sluggish reaction in 10 per cent. Thomson found 83 per cent of general paresis in 205 cases, with reflex pupillary agidity. Paralysis of accommodation is of far less frequent occurrence than pupillary anomalies, Moeli only attributing 1.5 per cent in all cases.

Manifestations in Congenital Syphilis

Stieren states that 50 per cent of syphilitic foetuses are still-born, and of the remainder four-fifths develop some form of ocular disease. Harman found 34 per cent of 1,100 cases of blind children due to syphilis. Some writers conclude, that outside of those cases due to ocular injuries, cataract, some forms of conjunctivitis and refractive errors, a half may be easily attributed to venereal origin.

Professor Fournier, as shown earlier, gives an example of syphilitic infection of the eyes. Gaucher, another French investigator, postulates that strabismus, and perhaps many cases of myopia, especially if the latter is an hereditary characteristic, are penalties of a paternal syphilitic inheritance, and moreover, that a person who squints, and who is also a son of a syphilitic, will beget squinting children. He also includes strabismus and myopia as being members of a category of manifestations comprising the remoter consequences of syphilis. The present writer is rather doubtful as regard the validity of such a sweeping statement, especially as regards that of strabismus. Gaucher illustrates his point from the following evidence which he himself had collected:

I Great-grandfather, died young from paraplegia (Syphilis of the spinal cord).

II Grandfather squinted without suffering from acquired syphilis. He died as a result of a hæmorrhage.

III This was succeeded into the third and fourth generation, where there were the hereditary influences of the great-grandfather, which produced among many of its manifestations that of strabismus.

The consideration of heredito-syphilis must also include that of the great-grandfather besides that of the grandfather. The previous example

was one of those observations to which he was alluding when considering the evidence of his theory.

Owing to the transmission of the specific poisons through the maternal tissues to the child and through other causations, congenital syphilis is generally a milder disease, in its effects upon the eyes. Intrauterine syphilis may, on the other hand, run its course more rapidly. The foetus in many instances dying of tertiary syphilis. As in the acquired form the Uveal Tract is the favorite seat of affection. Although Interstitial or Parenchymatous Keratitis is a fairly common condition, especially in females. It affects both sexes between the ages of five and forty-five years, occurring most frequently between the ages of seven and fifteen. The onset of Interstitial Keratitis varies greatly in the degree of corneal opacification. Fulminating cases are those when the cornea is opaque and the pupil is obliterated. The vision in Interstitial Keratitis is impaired in proportion to the density of infiltration. The severity of the disease may be gauged by the degree of vision left after the culmination of the disease. The specific treatment in the proper quarter may be judged by this test. Choroiditis in its various forms, Iritis and Cyclitis may develop and are sometimes accompanied by the softening of the eyeball. The eye may be primarily or secondarily affected during intrauterine life, or even during early childhood. Corneal opacities, Atrophy of the Choroid, Retinal involvements, etc., are frequently the result of intra-uterine meningitis of a syphilitic origin. Iritis occurs in congenital syphilis as a Primary Iritis. It is usually associated with untreated cases of Interstitial Keratitis, even after a lapse of many years. Often there is a severe Iritis in association with a Keratitis, but there is always some degree of Iritis present. In the acquired form of the disease the orbital walls may be involved. Many symptoms of the hereditary form are due to secondary changes and not as a direct result of infection. The evidences of syphilitic inheritance are well known and have been described in an earlier section, such evidences as the Hutchinson teeth, etc., have already been mentioned.

Manifestations in Gonorrhea

The most tragic gonorrheal infection of the human eye, is undoubtedly that of Ophthalmia Neonatorum. This is a preventable disease occurring in the newborn child. The disease is responsible according to some authorities for approximately 20 per cent of the blindness existing in the world today. The infection in the child's eyes, taking place during, before, or even a little while after the actual birth. The infection is derived from the vaginal discharge of the mother. The disease sometimes occurs in adults, when the infection is conveyed to the eyes from infected fingers, towels, handkerchiefs, etc. In the early stages of the disease the gonococcuc is found in fairly large amounts in the ocular discharge. There is always a grave risk of corneal ulceration as well. Both eyes are usually affected, and the conjunctiva is very inflamed red and swollen, at the same time discharging a thick yellow pus. Metastitic gonorrheal conjunc-

tivitis occurs in adults and is associated with gonorrheal arthritis. In about one-third of the cases the inflammation is complicated with other ocular infection situated elsewhere. Gonorrheal conjunctivitis occurs in adults and is rather a rare condition. Males seem to suffer more than females. The incubation period varies according to each individual case. This disease is also known as Acute Blenorrhea of adults and frequently leads to blindness owing to corneal infection. As one eye is usually involved before its fellow, attempts to prevent infection in the sound eye are made by using a "Buller's Shield," which consists of a watch glass stuck round the good eye by means of adhesive plaster, so that virtually it is hermetically sealed.

Primary iritis is also caused through gonorrhea even though the disease may have been contracted many years previously. The pain in the acute iritis is more severe than that of the syphilitic variety. The pain is of a neuralgic character. Gonorrheal Iritis develops where the general infection from gonorrhea has already arisen. It is also associated with gonorrheal rheumatism. Gonorrheal Iritis is always accompanied by intense conjunctival infection, which is probably due to the toxins. The gonococcus has occasionally been detected in the lacrymal sac in cases of congenital lacrymal obstruction. The metastatic gonorrheal inflammations of the optic nerve and retina generally assume the form of a very diffuse neuro-retinitis, associated at times with considerable retinal oedema. Pathological evidence favors the blood vessels rather than the lymphatic spaces as the conveying route of infection.

Manifestations in Soft Sores

Soft sores are occasionally found on the eyelids and conjunctiva, which may have been accidentally contaminated by means of infected fingers. The organism of Ducrey's Strepto-bacillus can be detected in the secretions obtained from the ulcers. Infections from the sores in the eyes are however comparatively infrequent.

Such are some of the venereal diseases of the eye, which consultant opticians may have the opportunity of encountering in their profession. Many are fairly common and others comparatively rare, and perhaps unlikely, if ever, to come our way, so that we can divert them to the proper quarter. Many ocular, or even general abstract diseased and pathological conditions, which cannot with any degree of certainty be traced to a definite cause, are put down to a latent venereal taint, because these diseases are far more widespread than is usually credited by the ordinary layman. The diseases themselves are no doubt the origin of "The sins of the fathers shall be handed down unto the third and fourth generation." Moral codes have varied at different times and in different parts of the world, but they have many unlerlying principles in common. Moral conduct has to be trained, whereas the animal instincts manifest themselves spontaneously. Even in the lowest stages, the greatest force of good conduct is the fear of the consequences. It requires considerable

development before we get the sentiment of the right and the wrong; the sentiment of duty and of conscience.

The detection and accurate diagnosis of the pathological conditions of the human eye are probably as important in our daily work as the accurate and careful determination of the refractive errors. Considering the most interesting fact, that according to reliable authority a good half of the cases of ocular disease may be attributed to venereal origin, whether long standing or recent, we must be on our guard, not only to be able to recognize them as such, but to take the necessary precautionary measures for our own sakes. Many cases we may encounter may be of long standing. The minority of them are of the malignant active type. There are not many consulting opticians who have had the opportunity of observing such forms as gummata or Hunterian chancres. These conditions often go directly into medical hands, but sometimes we may have the opportunity of seeing these conditions for ourselves, before sending the patient off to the nearest hospital which deals with venereal diseases specifically. The writer has seen some cases of venereal disease at the London Refraction Hospital, and will never forget his feelings when he first had the opportunity of examining a case of Interstitial Keratitis. The writer has encountered on several occasions other forms of venereal disease, such as syphilitic retinitis, optic athrophy in tabes, chorio-retinitis and iritis, etc. The writer has in his possession a letter from a librarian of one of the finest libraries belonging to a medical institution, in which it is stated that there are no treatises or monographs in English on venereal diseases of the eye, because they form too minute a a division of the subject. This is not strictly correct. The present writer maintains that such a subject is worthy of greater scope, and is of sufficient importance to merit exclusive treatment in a text book. The eyes, though themselves a small part of the human anatomy, are the gateways of the mind.

In conclusion, the writer wishes to acknowledge the report sent to him from the London Lock Hospital, for Venereal Disease, covering a year's work on the ophthalmic cases. It must be remembered that many cases of ocular involvements are treated in the out-patients' department, hence it will be noted that no cases of gummata or primary sores are mentioned in the report. It was also hoped that the writer would be able to visit this hospital, but the authorities did not consider it worthwhile as there were, at the time of writing, no ophthalmic cases in the in-patients' department.

The following report is a verbatim copy of that supplied by Mr. R. Lindsay Rea, F.R.C.S. to the London Lock Hospital, of the past year's cases of ocular manifestation in Venereal Diseases:—

EYE REPORT

"During the past year I saw over 30 Opthalmic cases which had been infected by venereal disease. The same thorough treatment as in

previous years was carried out in each case with the result that there has not been a single case of blindness, nor has any patient lost an eye. Such a result speaks volumes for the treatment given in each case, not only local treatment to the eyes, but the attention given to the physical well-being of each case.

"Twenty-one cases were seen at the London Lock Hospital, the remainder being seen by me at an Opthalmic Hospital at which I could have the patients examined very thoroughly from the ophthalmic point of view. These latter cases had suffered severely from various forms of venereal disease but I was anxious to follow them up, and in not a single instance has there been a relapse."

The following is a summary of the cases treated at the London Lock Hospital:

Babies

One baby, born ten minutes after admission of the mother to this Hospital, developed a very acute Gonococcal Ophthalmia. The infection in the mother had received no treatment previously, and it looked as if the baby had been infected before birth. The results of treatment (extending over 76 days) however were very good and this case demonstrated the need of ante-natal treatment in mothers.

Five babies, aged 2 days, 4 weeks, 4 weeks, 4 weeks and 6 weeks, were admitted to the Eye Ward from the London area. All the cases recovered satisfactorily.

Children

One male, aged 18 months, was admitted from the London area suffering from a Gonococcal Urethritis and Gonococcal Ophthalmia; both conditions were treated successfully over a period of 52 days.

Two male children, aged 3 and 5 years, were admitted from the London area, suffering from Ophthalmia. One case was a mild Gonococcal infection and both patients cleared up satisfactorily in 3 and 5 days respectively.

One girl, aged 12 years, suffering from congenital syphilis, was admitted to the Eye Ward from a London Orphanage, suffering from an acute Syphilitic Keratitis. In this case, the results of treatment were dramatic and the patient was greatly benefited over a period of 84 days.

Female In-Patients
Adults

One female, aged 18 years, suffering from Congenital Syphilis, developed a fulminating Interstitial Keratitis while in hospital. In this case, treatment extended over a period of 54 days, and in spite of the severity of the condition the after result was satisfactory.

One female, aged 40 years, was admitted to the Eye Ward from the London area, suffering from a neglected and very severe Gonococcal Ophthalmia. Owing to the age of the patient the severity of the infection and the late application for treatment, there was a slight scarring of the cornea. However, it was considered a very fortunate result and the patient expressed her gratitude profusely after 44 days of In-patient treatment.

One female, aged 19 years, was admitted to the Eye Ward from the London area, suffering from Gonococcal Iritis and Gonococcal Ophthalmia. Again treatment extending over a period of 27 days gave satisfactory results.

One female, aged 26 years, was admitted to the Eye Ward, suffering from Gonococcal Ophthalmia. The treatment extended over 26 days with a speedy recovery.

Male In-Patients
Adults

Four males, aged 19, 36, 18 and 17 years, suffering from Gonococcal Ophthalmia, were treated over a period of 94 days, 89 days, 29 days, and 10 days respectively. All these cases had a satisfactory termination.

Three males, aged 25, 34 and 24 years, were admitted to the Hospital suffering from Gonococcal Iritis. Here treatment extended over a period of 108 days in one case, while two cases continue treatment during the present year.

MR. W. GASSON, F.B.O.A., F.S.M.C.
CONSULTING OPHTHALMIC OPTICIAN
111, THE PARADE
HIGH STREET
WATFORD, HERTS, ENGLAND

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EDITORS

DR. CAREL C. KOCH
1501 Foshay Tower
821 Marquette Avenue
Minneapolis, Minn.

DR. JACK I. KURTZ
1501 Foshay Tower
821 Marquette Avenue
Minneapolis, Minn.

Original papers, scientific communications, clinical reports, society proceedings, books for review, and correspondence should be sent to the Editor, Dr. Carel C. Koch.

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THE PSYCHOLOGY OF STEREOSCOPIC VISION

Numerous theories and explanations are advanced from time to time regarding the conception of stereoscopic vision. The latest suggestion that retinal rivalry plays an important part in stereoscopic vision was made by Professor M. F. Washburn before the National Academy of Science of America. Washburn contends that the experience we call solidity comes to us not through the sense of sight but through the sense of touch, and sensations from the contractions of our muscles and the straining of our tendons as we surround a solid object with our hands. It cannot be obtained directly from vision. When we say that an object looks solid, we mean that it looks as if it would feel solid. Something involved in the experience of looking at it suggests the tactual and motor experience of solidity.

Quite a number of features involved in the experience of looking at a solid object suggests that it would feel solid if we handled it. Some of these suggest solidity even when we look at the object with one eye shut. Such are the features which the painter uses to give solidity and depth to his pictures, i.e., perspective, indistinctness of outline and less

saturation in color or distant objects, making near objects overlap more distant ones, etc. The more one observes experimentally the effect of these cues, the more one gets the impression that any one of them, although present in only a slight degree, will, if unopposed, make objects seem to have solidity and distance. It is as if since solid objects demand on the whole so much more important, active and varied responses than do flat objects, we never lose a chance of perceiving an object as solid.

Especially vivid suggestions of solidity come from the so-called stereoscopic factor. The traditional account of this factor states that when we look with both eyes at a solid object each eye sees a slightly different view of it, because the two eyes are situated at different points. Hence whenever two thus unlike images of an object from a stereoscopic slide for instance, fall upon corresponding points of the two retinae, we infer on the basis of experience that the object would feel solid. Perrin states: "This (the dissimilarity of the two retinal images) is the natural and habitual situation that obtains when one views a solid object, hence when this condition is reproduced artificially (as in the stereoscope) we have the visual illusion of depth."

Theories Criticised

Dr. Washburn has never felt quite convinced by this explanation because it makes the suggestion of solidity and depth come from a pattern on the retinae, which is a static thing, whereas solidity is something that involves the suggestion of movement. Further, if we draw on each side of the stereoscopic slide a pattern which combines the right eye and left eye views of the object, there is no reason why, if solidity depends upon the combined retinal pattern, such a slide should not in the stereoscope give solidity to the object. Such a slide, however, looks flat when viewed through the stereoscope. If a slide carries a vertical line on one side and a horizontal line on the other, when it is looked at through a stereoscope a cross appears which is indistinguishable from the one that would appear if a cross were drawn on both sides. It follows then that the stereoscopic perception of solidity is not derived from a retinal pattern composed of two images of an object obtained from different points of view.

What then is the nature of the stereoscopic factor? How does the unlikeness of the views which the two eyes get if a solid object act to suggest that the object will feel solid when handled.

Retinal Rivalry Explained

The following experiment makes one experience the immediate effect of the stereoscopic factor. If you look at a scene for a few seconds with the right eye closed, you will perceive distance and the solidity of objects by perspective, shading and overlapping of distant objects by near ones. Now if you open the closed eye, you will see something jump from right to left. The something that appears to jump or thrust is of course the right eye's image of the scene, which shows more of the right side of the objects before you and consequently makes their right sides seem to expand.

This sudden thrust, as an apparent movement, seems more appropriate than a static retinal image to suggest so motor an experience as solidity.

The apparent movement of the left edge of objects from right to left as the right side of object seems to expand is as a matter of fact quite similar to the movement this edge would make if it came obliquely *nearer* the observer, and the reaction of adjusting oneself to its approach in the third dimensions is very naturally suggested.

We do not go about consciously viewing objects first with one eye and then with the other and getting the suggestion of solidity from this process, yet in ordinary vision with both eyes open it has been shown that there goes on automatically an alternation of the two retinal fields. This is called retinal rivalry.

When a slide half red and half blue is looked at through a stereoscope, one eye is stimulated only by red, and the other only by blue. What one sees is part of the time purple, as the two fields combine, part of the time nothing but red and part of the time nothing but blue. That is, part of the time one is seeing with both eyes; part of the time only with the right eye, as if the left eye were closed or blind, and part of the time only with the left eye.

This same retinal rivalry occurs when the stereoscope is used with slides which bear the right eye and left eye images of solid objects, as for instance, with one of a truncated cone. In some recent experiments by Vassar, sixteen out of nineteen persons who looked steadily at the inner small circle for two minutes or longer saw the outer, larger circle shift from side to side as the left or right eye dominated.

This same retinal rivalry occurs not only in simple stereoscopic diagrams but also in stereoscopic photographs. This retinal rivalry is complicated by the interest or attention evoked by different parts of the picture. It is impossible for a less interesting object to suppress a more interesting one and retinal rivalry only takes effect in those parts of the two visual fields which are equal in attention value. This occurs especially at the edges of the picture. The alternation occurs not at the point looked at, but one observes it going on in the background. And it is just in these regions which alternate that we observe the strongest suggestion of depth and distance between the object and the background.

This same alternation due to retinal rivalry occurs in the ordinary vision of solid objects. If you select a point in your field of vision, say on the edge of an object and by opening and closing each eye alternately observe that the images of the background behind the edge are different for the right and left eyes, and if you look steadily at the point selected, you will soon see alternation of the two backgrounds, provided one of them is not dominant in attention because of some bright spot or interesting detail not visible to the other eye. Nothing but retinal rivalry can produce such an alternation.

So far as the writer has been able to ascertain this is the first record of retinal rivalry in connection with ordinary vision of solid objects. Dove, however, mentions something of this in connection with stereoscopic vision. Dove in 1841 reported that depth and relief can be perceived when the stereogram is illuminated by means of an electric spark. This of course gives no time for retinal rivalry to take place; it also suggests that a modification is needed to the theory that stereoscopic vision is due to slight changes of convergence.

Indeed, Donders, in 1867, after reporting a number of experiments tending to show that the perception of slight differences in the distance of objects cannot occur without eye movements, changes in convergence, abandons this position as a result of repeating Dove's experiment. He admits, however, that while the correct impression of depth was obtained with the first spark, some observers needed two or three sparks and some never got it.

In 1910 Karpinska made a thorough study of the impressions of depth under spark illumination. The observers in these experiments did not know beforehand whether the objects would be solid or flat. Under these conditions one spark was not enough. The impressions of the observers went through four phases of judgment with successive illumination before solidity was clearly perceived. Thus the reliability of the statement that the perception of solidity occurs in the instant of illumination by an electric spark also appears doubtful.

Washburn claims that no one has hitherto suggested that retinal rivalry plays an important part in the perception of solidity; but from the evidence presented in this paper, such a conclusion seems probable.

J. I. K.

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THE RESEARCH FOUNDATION OF THE PENNSYLVANIA COLLEGE OF OPTOMETRY

Since our editorial on the need of optometric education and research, which appeared in the June issue of this Journal, we are pleased to note that some action is being taken in different quarters to meet these problems. Last month we reported about the Graduate Course in optometry which was given at the University of Minnesota under the auspices of the Minnesota Academy of Optometry and the American Journal of Optometry. Many leading educators and scientists participated and helped make that course a success, and plans were perfected to make this an annual event.

Now we are pleased to announce that a research organization has been recently organized to promote optometric research, namely the Research Foundation of the Pennsylvania College of Optometry. The purpose of the foundation will be to encourage research in Ocular Science

and in all allied science, and the dissemination of the results of all scientific material developed by the Foundation by periodic reports and demonstrations at the annual meeting at the Pennsylvania College of Optometry. The research work of the Foundation is to be financed by the annual dues of the Membership as well as by contributions.

The following quotation from an announcement of the new organization will serve to illustrate what the founders of the Foundation aim to accomplish: "At the present time there is no organization in Optometry that is entirely disinterested, from a financial standpoint, in the relative merits of the different theories and teachings of Optometry, nor without financial interest in instruments of some kind or other, which has the facilities of a proving ground for us. The Research Foundation will have all of the facilities for research and proof; including the several faculty members, laboratories and the clinic through which some 17,000 people passed last year.

"The Pennsylvania College of Optometry is a non-profit organization owned entirely by Optometrists and exists for Optometry. They will sell us nothing but they will give us anything possible. All our funds need be used for is the co-relating and disseminating of optometric information which will be PROVEN FACTS."

It is hoped that individual optometrists as well as state associations and the A.O.A. will all help financially to make this Optometric Research Foundation an outstanding success. We feel confident that under the able leadership of Professor Edwin Tate and his associates on the faculty a research program may be carried out which will prove to be of the greatest benefit to our profession.

Dr. Forrest L. Betts, Cleveland, Ohio, is the president of the Foundation and further information may be obtained by writing to Dr. Betts or to the Pennsylvania College of Optometry at Philadelphia.

Few Optometrists are probably aware of the fact that the American Academy of Optometry under the able direction of Prof. Edwin Tait is fostering an extensive research program. Optometric Research is now carried on by a number of optometrists in the following universities: Temple, Pennsylvania, Columbia, Dartmouth, California, Minnesota and Syracuse. This is quite an ambitious and extensive program of research for an organization with a very limited membership. How much more could be accomplished if the A.O.A. with its thousands of members would back this and other research projects financially.

We feel confident that with the awakening of interest in education and research, these problems will be given greater consideration at the future A.O.A. conventions then they have received in the past.

All these signs are encouraging and it looks that optometric education and research so long neglected is at last being given serious consideration and we hope that the work of the Foundation will be crowned with success.

J. I. K.

HYGIENE OF ILLUMINATION

In the October issue of this Journal an editorial was published entitled "Hygiene of Illumination." This was an abstract from a lecture given by Prof. M. A. Tinker of the University of Minnesota before the Minnesota Academy of Optometry. In this lecture Tinker claimed that in semi-indirect or direct illumination a brightness of 2 to 3 foot-candles to be better than higher intensities and in case of indirect illumination 5 to 8 foot-candles may be considered adequate for ordinary reading.

Luckiesh and Moss on the other hand claim that a greater quantity of light is needed as may be seen from this quotation from a paper delivered before the Illuminating Engineering Society.[1] In discussing the quantity of light they state that the foot-candle recommendations of the past are inherently arbitrary values. In fact, all foot-candle recommendations are excepting those for barely seeing and for optimum ease of seeing. At present the optimum levels of illumination for most tasks are far above the range of foot-candle recommendations and in many cases are far above the practicable or attainable levels of illumination by artificial light.[a] Hence, foot-candle recommendations lower than the ideal intensities possess no inherent justification in the absolute or purely scientific sense. However, intensities of illumination which are specified in accordance with the difficulty of the visual task may be scientifically exact in a relative sense, even though they are far below the ideal levels of illumination.[1b] The technique for evolving such recommendations is an important part of the science of seeing.

A conspicuous characteristic of numerous and diversified visual researches is that similar relationships are obtained between foot-candle intensity and the various experimental criteria, such as acuity, speed of vision, nervous muscular tension, etc. Specifically, these researches indicate that intensity of illumination must be varied in geometric increments in order to secure arithmetic increments of improvement in seeing.[a] This geometric relationship of quantity of light to seeing may conveniently be termed the *foot-candle scale of effectiveness*. Although it is indeterminate as an absolute scale, *it is exact as a relative scale*. This relationship is applicable, with few exceptions, to all phases of seeing which involve foot-candles as a variable. However, in practice it is not convenient to use a scale of foot-candle effectiveness which is an exact geometric progression. Such a scale, in addition to the inconvenient divisions, would connote an unwarranted precision not suggested by round numbers. Hence, the following approximate scale of foot-candle effectiveness has been proposed[9] and is becoming accepted.

1 2 5 10 20 50 100 200 500 1000

The foot-candle steps of this scale represent approximately equal contributions to improvement in seeing. The interval between any two

[1]The New Science of Lighting by M. Luckiesh and F. K. Moss. Lighting Research Laboratory, Nela Park, Cleveland, Ohio. Copy of this lecture may be obtained by writing direct to Dr. Luckiesh.

successive steps represents the minimum difference in level of illumination which can be justified upon the basis of an observable improvement in seeing. For example, a recommendation for an increase in intensity of illumination from 10 to 100 foot-candles is interpretable, on this scale, as an increase in seeing of three minimum steps. In general, it is practicable and permissible to state that the intensity of illumination must be doubled in order to obtain an obvious and significant improvement in seeing.

The following foot-candle recommendations for common tasks of the work-world are quite conservative from the viewpoint of the new science of seeing. They are frankly a compromise between optimum values (which are known to be much greater) and prevalent values or those obtainable satisfactorily by available installations or methods of lighting. These recommended foot-candles are far below the intensities of illumination which new knowledge indicates to be ideal but they represent a great advance over former recommendations based upon inadequate data and a restricted view-point. They are based upon the approximate geometric scale of foot-candle effectiveness combined with new knowledge pertaining to relative difficulty of visual tasks.

100 Foot-candles or More—For very severe and prolonged tasks, such as fine needlework, fine engraving, fine penwork, fine assembly, sewing on dark goods and discrimination of fine details of low contrast, as in inspection.

50 to 100 Foot-candles—For severe and prolonged tasks, such as proofreading, drafting, difficult reading, watch repairing, fine machinework, average sewing and other needlework.

20 to 50 Foot-candles—For moderately critical and prolonged tasks, such as clerical work, ordinary reading, common benchwork and average sewing and other needlework on light goods.

10 to 20 Foot-candles—For moderate and prolonged tasks of office and factory and when not prolonged, ordinary reading and sewing on light goods.

5 to 10 Foot-candles—For visually controlled work in which seeing is important, but more or less interrupted or casual and does not involve discrimination of fine details or low contrasts.

0 to 5 Foot-candles—The danger zone for severe visual tasks, and for quick and certain seeing. Satisfactory for perceiving larger objects and for casual seeing.

In view of the fact that there is such a disagreement in the findings of these investigators it is urged that further study be carried out on this all important subject until a closer agreement is obtained as to the quantity of illumination best suited for near work. J. I. K.